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# (54) REACTOR HEAD FOR CHEMICAL REACTORS

(71) I, ADOLF FINK, of 2 in der Rüti, 4104 Oberwil, Switzerland, a citizen of the Swiss Confederation, do hereby declare the invention, for which I pray that a patent may be granted to me, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to gas/liquid phase chemical reactors, i.e., reactors adapted to allow direct reaction between a gaseous phase and a liquid phase and more specifically to reactor heads for such reactors.

In gas/liquid phase chemical reactors, the provisions of mixing means is generally advantageous to ensure thorough mixing of the reaction phases and thereby efficient reaction, and to this end a stirrer is often provided. In cases where a stirrer is employed, bearing elements are generally used to satisfactorily mount the stirrer, and prevention of escape of gas past the stirrer or bearing elements is generally achieved by the provision of sealing elements. It is frequently found however that such sealing and bearing elements are prone to corrosion by certain reaction media, e.g., reaction media containing active catalysts, although in many cases the corrosion is not due to the gas phase *per se* but to the reaction mixture or the liquid phase. The avoidance of corrosion has been approached in various ways. Thus, shaking machines and vibration mixers have been employed. However, the size of the shaking machines is limited and reaction vessels of special designs are often required. In the case of vibration mixers, the susceptibility to diaphragm breakage is a great disadvantage. Magnetic rod stirrers have been employed, but in general are limited to reaction mixture volumes of up to about 100 cc.

The present invention provides a reactor head for a gas/liquid phase chemical reactor which reactor head is adapted to be connected to the neck of the reaction vessel and is provided with a shaft for a stirrer, which shaft penetrates movably through an element exposed to the atmosphere outside the reactor head, and a passage within the reactor head along which passage gas to be supplied to the reaction vessel can flow, the said passage opening adjacent to the element penetrated by the shaft to maintain gas flow in the vicinity of the element in a direction generally away from the region of the element.

The element is usually a sealing element or a bearing element, or may be an element which has both a sealing and bearing action simultaneously.

With the said passage so disposed the corrosive action of the reaction mixture on the element may be at least reduced by the protective action of a non-corrosive gas phase.

A gas/liquid phase chemical reactor which includes such a reactor head and a reaction vessel is a further aspect of the present invention. The passage in the reactor head may, at least in part, conveniently be disposed generally coaxially about the said shaft for the stirrer. A part of the passage adjacent the opening thereof may be defined by a channel by-passing the element and running alongside the element extending the length thereof and parallel to the shaft for the stirrer.

The reactor head may include a stirrer which may, for example, be integrally formed with the said shaft.

In one preferred form of the invention, the reactor head includes a magnetic coupling to enable drive to be transmitted from a drive shaft to the said shaft for the stirrer. Such form is of particular advantage when a gas-tight sealing cap is included separating the drive shaft and shaft for the stirrer one from the other.

In some cases protection of the element may be further improved by the provision of an annular deflector plate mounted on the shaft at a position adjacent the element in which the deflector plate is to be exposed to the reaction vessel when the reac-

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tor head is connected to the neck thereof. On rotation of the stirrer and thereby the deflector plate, any corrosive reaction mixture penetrating the protective gas counterflow barrier set up by the flow of gas out of the passage will strike the deflector plate and be scattered radially outwardly thereof by centrifugal force.

One preferred embodiment of the invention will now be described in more detail with reference to the accompanying drawing which shows an axial section through the reactor head region of a gas/liquid phase chemical reactor.

The gas/liquid phase chemical reactor shown in part in the drawing comprises a reactor head generally designated by reference numeral 1, connected to a reaction vessel generally designated by reference numeral 4.

The reaction vessel is of standard form and comprises a neck 16, into which the reactor head is inserted, and a reaction vessel bulb (not shown).

The reactor head 1 comprises a reactor head block 10 provided with a central bore 51. The bore 51 houses a tubular bearing support 24, supporting a pair of terminally disposed bearing elements *7a* and *7b*. Extending the length of the central bore 51 of the reactor head block 10 and rotatably mounted in the bearing elements *7a* and *7b* is a shaft 6. One end of the reactor block 10 is tapered to conform to the internal shape of the reaction vessel neck 16 to constitute an insert portion 5 of the reactor head 1. A passage generally designated by reference numeral 2, which is to serve as a gas inlet for the reaction vessel 4 comprises a gas inlet tube 3, provided with a gas inlet nipple, extending transversely of the block in gas communication with a gas inlet passage *2c* extending within the bearing support 24 generally coaxially about the shaft 6. The gas inlet passage *2c* extends to the bearing element *7a*, and is in communication with a channel *2a* in the bearing support 24, which channel *2a* runs alongside and extends along the length of the bearing element *7a*, one of its enclosing walls being provided by the element, thus by-passing it. The gas inlet 2 emerges from the reactor head block and opens into the reaction vessel 4 at orifice *2b*.

The bearing element *7a*, as well as acting as a bearing, thus serves to define (with bearing support 24) the opening of passage 2 into reaction vessel 4 and simultaneously acts as a sealing element preventing escape of gases from the reaction vessel 4.

The shaft 6 is connected to a drive shaft 19 via a magnetic coupling 11. The magnetic coupling 11 comprises a magnetic core 20 keyed at 30 to the head of the shaft 6. Around the magnetic core 20 is rotatably mounted a magnetic sleeve 22 keyed at 34 to the drive shaft 19. The magnetic core 20 is separated from the magnetic sleeve 22 by a gas-tight sealing cap 21. The magnetic coupling 11 is enclosed in a housing 23 arranged at the end of the reactor head block 10 remote from the insert portion 5 of the reactor head 1, which housing supports bearing elements 37 in which the drive shaft 19 is rotatably mounted. The reactor head 1 is provided with a support arm 39 connected to the magnetic coupling housing 23.

Adjacent the foot of the shaft 6 and exposed to the reaction vessel 4 is connected an annular deflector plate 9 disposed adjacent the bearing element *7a* and the gas inlet orifice *2b*, to prevent direct exposure of the bearing element *7a* and gas inlet orifice *2b* to the contents of the reaction vessel bulb (not shown). Also connected to the foot of the shaft 6 by a pin 27 is a stirrer 17 (only partly shown).

The insert portion 5 of the reactor head 1 is accommodated in the neck of the reaction vessel 4 and is maintained in position and in gas tight relation with respect to the reaction vessel neck 16 by means of a collar 12 in screwthreaded engagement with the reactor block 10, a rubber "O" ring 13 and gasket 14 ensuring a gas tight connection.

The operation of the gas/liquid phase chemical reactor of the preferred embodiment and in particular the operation of the reactor head will now be described.

The liquid phase of a gas/liquid phase reaction is metered out into the reaction vessel 4 and the reactor head inserted into the neck 16 of the reaction vessel and connected thereto by means of the collar 12. Support arm 39 is then clamped into position in conventional manner on a suitable support frame.

The drive shaft 19 is coupled to a power source (not shown) and drive is transmitted via the magnetic coupling 11 to the shaft 6 and thence to the stirrer 17 and deflector plate 9 to cause stirring of the liquid in the reaction vessel bulb and rotation of the deflector plate 9. The gas phase of the gas/liquid phase reaction is admitted through the gas inlet 2, i.e., down the gas inlet passage *2c* alongside and past the bearing element *7a* via the bearing element by-pass channel *2a*, out of the gas inlet orifice *2b* and down into the reaction vessel bulb.

In view of the gas stream flowing away from the terminal bearing element *7a* the tendency for corrosive reaction mixture in the reaction vessel bulb to contact and thereby corrode the sensitive bearing element is at least reduced. Such tendency is furthermore reduced by the deflector plate 9 which causes any droplets of reaction mixture that penetrate the protective gas flow

barrier, on contact to be scattered radially outwardly across the gas flow and against the sides of the reaction vessel, to run down the walls of the reaction vessel neck or be swept down by the gas flow into the reaction vessel bulb. The use of the magnetic coupling, and more specifically the sealing cap 21, between the magnetic coupling driven-and drive-elements allows an effective seal against escape of gas from the reactor. Moreover, by virtue of the gas flow down the neck of the flask and directly into the vortex of the reaction mixture set up by the action of the stirrer, an efficient manner of gas/liquid phase interaction is allowed.

WHAT I CLAIM IS:—

1. A reactor head for a gas/liquid phase chemical reactor which reactor head is adapted to be connected to the neck of a reaction vessel and is provided with a shaft for a stirrer, which shaft penetrates movably through an element exposed to the atmosphere outside the reactor head, and a passage in the reactor head along which passage gas to be supplied to the reaction vessel can flow, the said passage opening adjacent to the element penetrated by the shaft to maintain gas flow in the vicinity of the element in a direction generally away from the region of the element.

2. A reactor head according to claim 1, wherein at least a part of the said passage is disposed generally coaxially about the said shaft.

3. A reactor head according to claim 1 or claim 2, wherein the said passage includes a channel running alongside the said element and extending along the length thereof parallel to the said shaft for the stirrer.

4. A reactor head according to any one of the preceding claims, which includes an annular deflector plate mounted on the said shaft and adjacent the said element.

5. A reactor head according to any one of the preceding claims, including a stirrer operable by the said shaft for stirring the contents of a reaction vessel.

6. A reactor head according to claim 5, wherein the stirrer is integrally formed with the said shaft.

7. A reactor head according to any one of the preceding claims, which includes a magnetic coupling to enable drive to be transmitted from a drive shaft to the said shaft for the stirrer.

8. A reactor head according to claim 7, wherein the drive shaft and the said shaft for the stirrer in the magnetic coupling are separated one from the other by a gas-tight sealing cap.

9. A reactor head constructed and arranged substantially as described herein with reference to the accompanying drawing.

10. A gas/liquid phase chemical reactor including a reactor head according to any one of the preceding claims and a reaction vessel for the reactants.

11. A gas/liquid phase chemical reactor substantially as herein described with reference to the accompanying drawing.

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1 SHEET *This drawing is a reproduction of the Original on a reduced scale*